Factors and Methods Relating Land Use and Transportation Plans to VMT and CO_2

The Relationships

VMT Benefits of Compact Development

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Vehicle travel 20% to 40% lower in dense, diverse, well-designed neighborhoods vs conventional suburbs

VMT Benefits of Compact, Central Development

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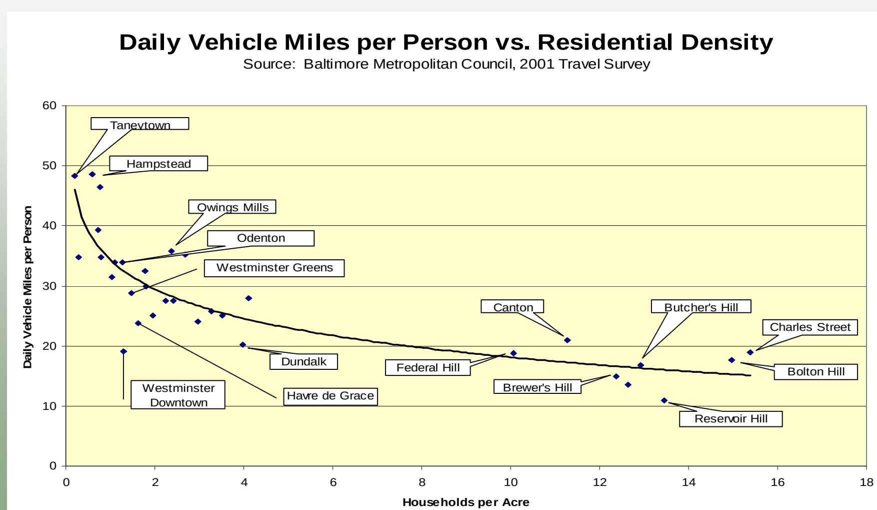
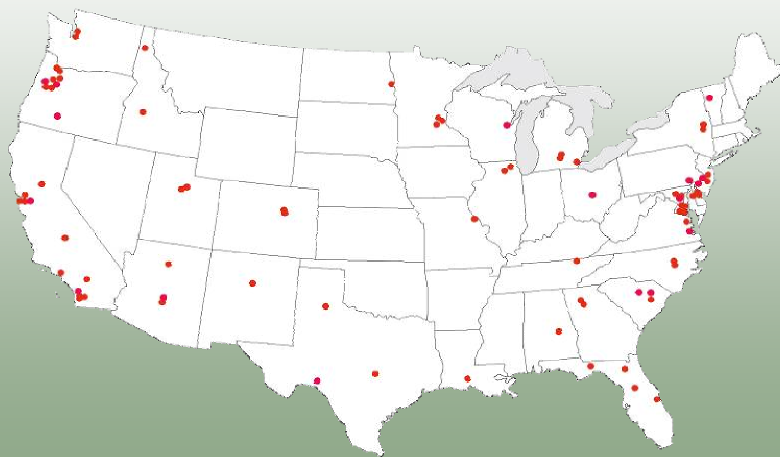
Region-wide neighborhood comparison: 2/3rd VMT reduction for central compact neighborhoods



US Land Scenario Planning Studies

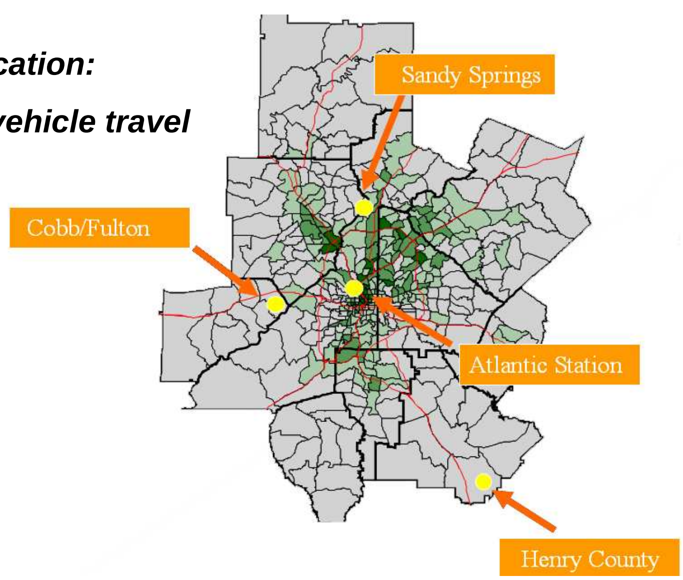
26% VMT reduction by 2050 in 62 study locations



Location-Specific Studies

Central location:

33% less vehicle travel



Studies of Site-Plan Variations

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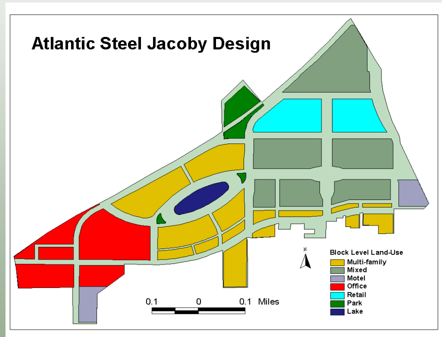
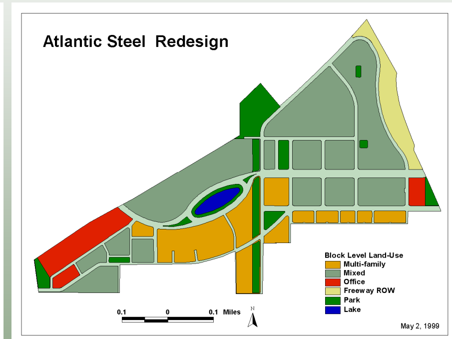
2% travel reduction due to site design





Atlantic Station – Successful Community

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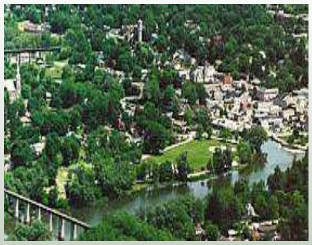
Lower VMT than Predicted

Modeling the Relationships

SB 375 Travel Modeling Capabilities

- Relationship between density and VMT consistent with statistical research
- Enhanced transit service impacts on VMT
- Induced travel and development from highway or passenger rail expansion

“D” Factors that Influence VMT



1. **Density** dwellings, jobs per acre
2. **Diversity** mix of housing, jobs, retail
3. **Design** connectivity, walkability
4. **Destinations** regional accessibility
5. **Distance to Transit** rail proximity
6. **Development Scale** pop, jobs
7. **Demographics** household size, income
8. **Demand Management** pricing, incentives

1. Density (jobs and dwellings per acre)

- **Shortens trip lengths**
- **More walking/biking**
- **Supports quality transit**

2. Diversity (mix of housing, jobs, retail)

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- Links trips, shortens distances
- More walking/ biking
- Allows shared parking

3. Design (connectivity, walkability)

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4. Destinations (accessibility to activities)

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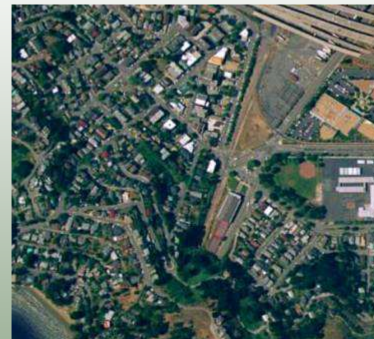

Development at infill or close-in locations reduces vehicle trips and miles

Typical 4D Elasticities

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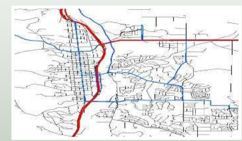
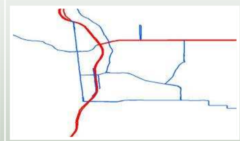
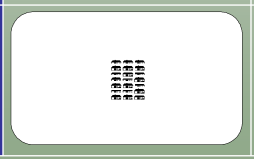
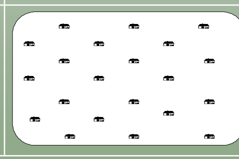
	Vehicle Trips Per Capita	VMT per Capita
Density	8%	9%
Diversity	6%	7%
Design	4%	7%
Destinations	17%	35%

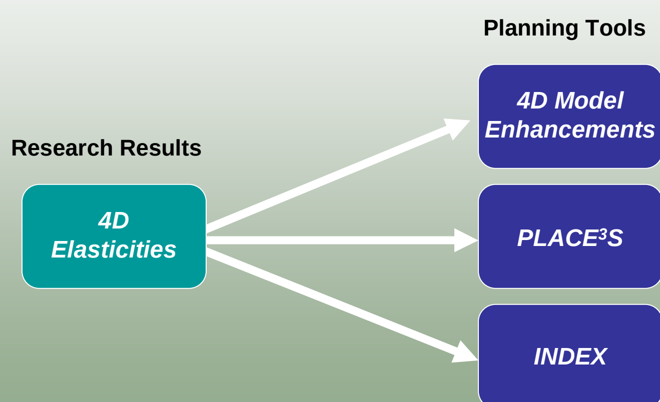
Sources: National Syntheses, Twin Cities, Sacramento, Holtzclaw

D’s Help Refine Travel Model Sensitivity

	Reality	Model’s View
Circulation Network		
Walking Environment		
Density, Clustering		

Caltrans Recommendation on 4D’s

Use D’s to compensate for any lack of sensitivity in travel models



- ***Source: Assessment of Local Models and Tools for Analyzing Smart-Growth Strategies,2007***

4D Experience in California

- EPA and Caltrans Recommendations
- SACOG Blueprint
- SLOCOG Vision Plan
- San Joaquin Valley Growth Response
- Contra Costa Shaping our Future
- Fresno COG Blueprint
- SANDAG Smart Growth Trip Generation
- SJCOG Blueprint (under consideration)

5. Distance from Transit (transit service level)

Vehicle-miles traveled, compared with regional average:

- 42% reduction for households within ½ mile of rail transit
- 21% reduction for households between ½ and 1 rail mile

Generating Transit Ridership, Reducing VMT

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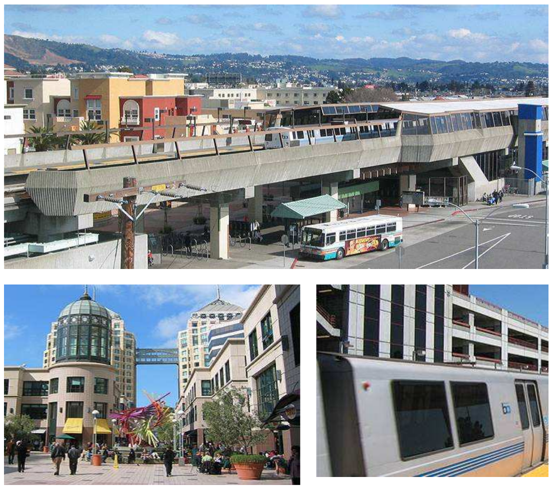

- TOD Population
- TOD Employment
- Catchment Population
- Parking Supply
- Train Frequency
- Feeder Bus Frequency
- Walk Connections
- Bike Parking

Examples: BART, Caltrain, Sacramento LRT, Salt Lake LRT, Denver RTD

Direct Transit Ridership Models

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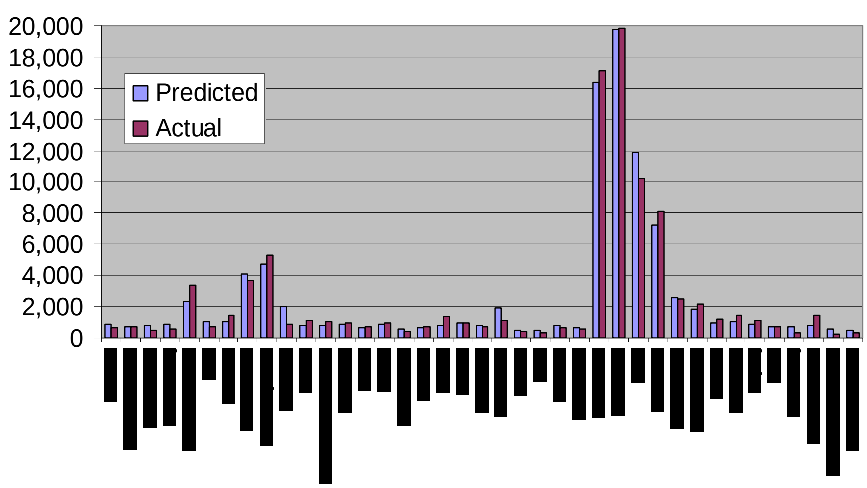
Model 1- Relationship Between PM Peak Boardings and 1/2 mile Non-Retail Employment, 1/2 mile Population, and Downtown SF Indicator, R2=.985



TOD Impact on Transit Ridership

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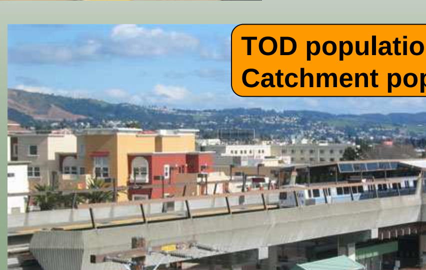
Station parking x .99
Off-site parking x .69

Peak buses x 60
Bike parking x 2.5



TOD population x .14
Catchment pop. x .004

Walk/Bike Access Share

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TOD Population x 0.12

TOD Employment x 0.14

Buses x -9.7

Bike Parking x 4.0

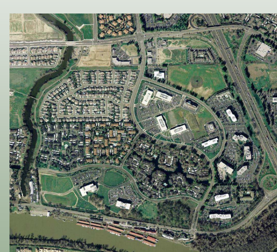
6+ Emerging Research

6. **Development scale**
7. **Demographics**
8. **Demand management**

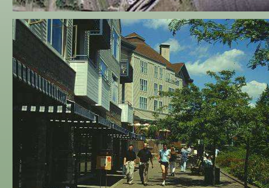
Nationwide Survey of Mixed-Use Travel

240 MXD in Sacramento, Portland, Seattle, Boston, Atlanta, Houston

Gateway Oaks, Sacramento



River Place, Portland



Factors Correlated with Reduced Travel*

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- Density of population and employment
- Diversity: jobs/housing relative to regional balance
- Diversity: balance of commercial, office, and public
- Design: intersections per square mile
- Destination Accessibility: jobs within 1 mile
- Destination Accessibility: jobs within a 30 min by transit
- Distance to Transit: rail station, bus stops within MXD

- Development Scale: MXD population and employment
- Demographics: household size, vehicle ownership

* Internal travel and walking, transit use, trip length

Validation: 15 Nationwide Validation Sites

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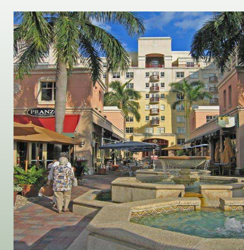
- 3 Northern California
- 3 Southern California
- 6 Florida
- 3 in Texas, Georgia

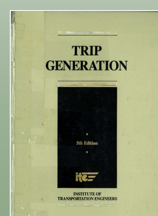


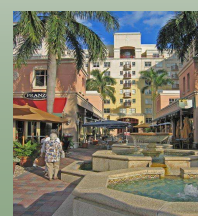
Comparison of MXD Model to ITE Methods

Preliminary

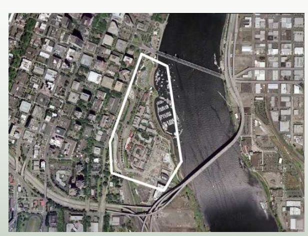
Errors in Estimates at 15 Locations

	ITE Rates	ITE Internal	7D MXD Model
External Vehicle Trips	44%	31%	0%





New Findings on Smart Growth Trip Generation



	MXD	TOD	Infill
Trip Discount	30%	44%	36%

Examples: San Diego, Seattle, Portland, Sacramento, Houston, Atlanta, Boston
Sources: EPA MXD, SANDAG SG TG, TCRP 128, Caltrans Urban Infill

Effects of Supply-Side Strategies

	Elasticity
Highway Lane Miles	+0.55
Transit Revenue Miles	-0.06
Real Fuel Price	-0.17

Sources:

Ewing, et al., *Growing Cooler: The Evidence on Urban Development and Climate Change,* ULI, 2008.

Ewing, Nelson, *CO2 Reductions Attributable to Smart Growth in California*, 2008

Induced Travel: Trade-Off Evaluation

- **Possible benefits of adding roadway capacity:**
  - **Improved flow stability and reduced CO2/VMT**
- **Possible adverse consequences:**
  - **Increased investment in auto-dependent corridors***
  - **Induced auto trips, longer trips, mode shift to auto***
  - **Increase in peak concentrations**
  - **Magnitude of effect depends on severity and duration of congestion, role of facility in regional multi-modal circulation**

**** Investing in transit corridor may have opposite effects***

Network Management Strategies

<u>Congestion Mitigation</u>

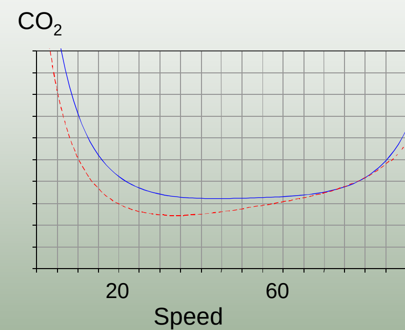
- Signal coordination
- Ramp metering
- Incident management

<u>Flow Smoothing Techniques</u>

- Variable speed limit
- Intelligent speed adaptation

<u>Speed Management</u>

- Improved enforcement
- Speed limiters
- Active accelerator pedal



Source:

Barth, Matthew; *ITS and the Environment,* UC

Factors with Quantifiable Effects on VMT, CO_2

<u>Land Use - Demand Side</u>

- Density
- Diversity
- Design
- Destination Accessibility
- Distance to Transit
- Development Scale
- Demographics
- Demand Management

<u>Transportation - Supply Side</u>

- Highway Lane Miles
- Transit Revenue Miles
- Induced Travel
- Pricing
- Network Management